

CSU Condensed Matter Physics Seminar

“Blurring the boundaries between topological and non-topological phenomena in dots”

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121 Engineering (Interaction Space)

Abstract

Topological insulators (TIs) are known to have unique characteristics that distinguish them from the rest of the other materials, named trivial insulators. More specifically, TIs are a new matter state that behave as an insulator in bulk and a metal in the edges (or surfaces). However, different from the usual metals, the TIs conduct electric current on the edge (or surfaces) without dissipation, thus yielding interesting technological applications. In this work, we find quite unexpectedly that some trivial quantum dots (QDs) are shown to be equivalent to topological QDs [1]. More specifically, we find that InAsBi trivial QDs host discrete helical edge states also protected against the elastic backscattering. In order to compare the trivial with the topological QD, we calculate the circulating currents [2] and two terminals conductance associated to both trivial and topological edge states and find no substantial difference between them [1]. Differently from the topological edge states, here, the protection of the trivial edge states is guaranteed under small QD radius. We show that this result does not depend on the QD geometry, but rather on the approximate chiral symmetry of the BHZ Hamiltonian of InAsBi material [2]. Last but not least, by considering the rapid band gap change within valence band anticrossing theory for InAs_{1-x}Bi_x/AlSb, we predict that Bi-alloyed quantum wells become $\approx 30\text{meV}$ gapped 2D topological insulators for well widths $d > 6.9\text{nm}$ and $x = 0.15$ [1].

Biography

I did my Bachelor, Master and PhD in the University of São Paulo, under the supervision of Prof. Carlos Egues. After that I went to University of Chicago where I spent 6 month as a visiting postdoctoral researcher within David's Awschalom group. Now I'm currently in the University of Iowa, in Iowa City working with Prof. Michael Flatté.

[1] Denis R. Candido, M. E. Flatté, J. Carlos Egues, Phys. Rev. Lett. **121**, 256804 (2018) [2] J. van Bree, A. Y. Silov, P. M. Koenraad, M. E. Flatté, Phys. Rev. Lett. **112**, 187201 (2014) [3] Denis R. Candido, M. Kharitonov, J. Carlos Egues, and E. Hankiewicz, Phys. Rev. B **98**, 161111(R) (2018) (Editors' Suggestion).